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AIR POLLUTANT EMISSION INVENTORY FOR THE STATE OF NEW HAMPSHIRE

Paul Morgenstern, et al

Walden Research Corporation

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SUMMARY REPORT

AIR POLLUTANT EMISSION INVENTORY FOR THE STATE OF NEW HAMPSHIRE

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and

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A summary is presented of the results from an inventory of air pollutant emissions within the State of New Hampshire. The contaminants considered included sulfur oxides, carbon monoxide, nitrogen oxides, hydrocarbons, and particulates. Estimates of the annual emission of the pollutants were developed for the year 1970 and summarized in this report. The emissions within each of these Regions are summarized by source type. A supplementary data report provides similar tabulations of the emissions by source type for each municipality in the state. The methodology for preparing the inventory consisted of first determining the consumption of fuels according to combustion sources for power, space heating, and other industrial process needs. The emission of pollutants arising from this set of sources is estimated by the application of appropriate emission factors in conjunction with selected fuel composition. For the case of particulate emissions, the factors also take cognizance of the reduction affected by existing installed control devices.

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359 Allston Street □□□□ Cambridge □□□□ Massachusetts □□□□ 02139 □□□□ 617/868/3940

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I. INTRODUCTION

This report presents a summary of the results from an inventory of air pollutant emissions within the State of New Hampshire. The survey is based on information collected previously by the New Hampshire Air Pollution Control Agency and supplemented by additional data assembled during the current study. The contaminants considered included sulfur oxides,* carbon monoxide, nitrogen oxides,** hydrocarbons,*** and particulates. Estimates of the annual emission of these pollutants were developed for the year 1970 and are summarized in this report.

The State of New Hampshire is divided among three Federally designated [1,2] Air Quality Control Regions (AQCR) as shown in Figure 1:

(1) Androscoggin Valley Interstate AQCR (Maine-N.H.)

Political jurisdictions within New Hampshire

Coos County

(2) Central New Hampshire Intrastate AQCR

Political jurisdictions within New Hampshire

Carroll County
Grafton County

(3) Merrimack Valley - Southern New Hampshire Interstate AQCR (Mass.-N.H.)

Political jurisdictions within New Hampshire

Belknap County
Chesire County
Hillsborough County
Merrimack County
Rockingham County
Strafford County
Sullivan County

This report presents the emissions within each of these Regions summarized by source type. A supplementary data report provides similar tabulations

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* Primarily expressed as sulfur dioxide.

** Primarily expressed as nitrogen dioxide.

*** Primarily expressed as methane.

of the emissions by source type for each municipality in the state.

The inventory data also have been summarized into a network of 77 grid squares for the Southern New Hampshire AQCR, supplemented by a statewide list of approximately 464 specific point emission sources. The grid square and point source information has been prepared in the form of punch card decks to facilitate further computer processing.

II. METHODOLOGY

The methodology used to prepare the inventory conforms with the rapid survey techniques developed by the National Air Pollution Control Administration [3,4]. In its simplest form, the basic plan of this approach consists of first determining the consumption of fuels according to combustion sources for power, space heating, and other industrial process needs. The emission of pollutants arising from this set of sources is estimated by the application of appropriate emission factors in conjunction with selected fuel composition parameters. For the case of particulate emissions, the factors also take cognizance of the reduction affected by existing installed control devices.

All pollutant emissions in the region can be broadly categorized as that from stationary sources and that from non-stationary (transportation) sources. The latter category includes all modes of combustion powered transportation including automobiles, buses, trucks, trains, vessels, and aircraft. Stationary sources may also be classified into different user categories and type of use as illustrated in Figure 2. The major categories of source types shown include domestic (residential), commercial, institutions, manufacturing, and steam-electric utilities. Most of these can be further classified as point sources which represent individual establishments using very large quantities of fuel, as distinguished from area sources which represent, collectively, a large number of smaller sources distributed over the survey district. The basic structure for classifying fuel consumption shown in Figure 2 was used in the current inventory. Aside from its general utility, this system allows for a subsequent comparison of the survey results with those completed in a similar manner for other control regions.

Solid waste refuse disposal represents an additional source of pollutants included in the inventory. Estimates of pollutant emissions arising from combustion of the solid waste material by municipal incinerators, open burning dumps, and backyard burning, are derived in a manner similar to the previous source types, e.g., by using appropriate emission factors.

In addition to emissions from combustion sources, contaminants may be discharged into the atmosphere as a consequence of industrial process operations. Process loss emission factors are commonly given in terms of production volume or weight of raw material processed, type of process equipment, control devices, etc. The current survey included these emissions in its scope when the appropriate process factors were available.

A. SURVEY AREA AND GRID COORDINATE SYSTEM

The Universal Transverse Mercator (UTM) coordinate system of the U.S. Army Map Service [5] has been used to locate emission sources in the State. The State of New Hampshire is covered by two such zones of the UTM system (zones 18 and 19), and since the coordinate system for each zone differs, it was necessary to modify the UTM system for the western portion of the State in order to provide a consistent system throughout. This modification consisted of extending the zone 19 coordinates to the western border of the State. The equations for the extended coordinate system relative to the zone 18 coordinates are given in Appendix A.

A network of grid squares was established for locating and summarizing the emissions from area type sources in the Southern New Hampshire AQCR. Four different size grid squares were used in this network. The smallest grid square is 2 km on each side and was used to summarize the emissions in the most highly urbanized metropolitan areas of the region. A square 4 km on each side was used to summarize the emissions in the outer sectors of metropolitan areas, while 8 and 16 km squares were used for the remaining rural parts of the region. The total network consists of 77 contiguous grid squares. The location of each grid square is given by the UTM coordinates of the center of the square. This grid square network is shown in Figure 3.

B. FUEL CONSUMPTION BY STATIONARY SOURCES

A survey was conducted on annual fuel consumption by stationary sources within the State during 1970. These data were assembled from a

mail and telephone questionnaire survey conducted by the New Hampshire Air Pollution Control Agency, and supplemented with information published in various reference sources. These results are given in Tables I-III and show total fuel consumption summarized by region and by user category. The sources of these data and the basis for further subdivision into city and town estimates are presented in the following sections.

1. Residential

The combustion of fuel by residential sources is primarily for space heating during the winter months, and other domestic uses throughout the year such as hot-water heating and cooking. The major types of fuel used for this purpose are coal, distillate heating oil, and natural gas.

The consumption of fuel for space heating can be calculated from information on the number of dwelling units using coal, oil, or natural gas. These fuel use patterns were developed in the current study by updating of Bureau of Census [6] data collected during the 1960 census. The updating considered both the changes in the total number of dwelling units within the past decade, and the trend toward increased use of oil and natural gas for home heating with a decline in the use of coal.

Changes in the number of housing units were based in part on advance tabulations from the 1970 census for the cities and towns with at least 10,000 inhabitants [7]. For the remaining cities and towns in the State, advance population tabulations from the 1970 census were used to derive 1970 housing units [8]. Trends in new heating unit installations, and in the conversion of older burner units were derived from a comparison of 1960-1970 reports on residential oil burners in use [9], and sales of coal by retail dealers [10]. These trends were applied to the updated housing unit file to produce a base for calculating 1970 home heating fuel oil and coal consumption. The adjustments were made separately for Standard Metropolitan Statistical Areas (SMSA) and for non-SMSA areas within the State to reflect differences in fuel use patterns within these

areas. Consumption of natural gas was obtained directly from utility company sales data.

The calculation of fuel oil and coal* consumption for space heating purposes considered regional and local differences in annual heating degree-days [11]. Non-space heating use of fuel for hot water heating and cooking also was included in the computations.

2. Commercial

The commercial category constitutes fuel consumption by a broad range of business, semi-public, and public facilities, primarily for satisfying space heating requirements. It includes retail and wholesale trade establishments, financial, real estate and insurance business operations, as well as numerous personal and business service industries. Also included in this grouping are recreation, entertainment and athletic facilities as well as semi-public institutions such as hospitals, universities, cultural and religious centers. Public buildings comprising this class include local, State, and Federal offices, primary and secondary schools, fire and police stations, public works buildings, post offices, etc.

The consumption of distillate oil was estimated from total shipments of heating oil to New Hampshire during 1969 reported by the Bureau of Mines [12] and extrapolated to 1970. This extrapolation was based on a review of the trend in shipments over the past eight years. Separation of the commercial component from the total was based on experience with previous inventories [13] which indicated that 10 percent of the #2 oil shipments and 100 percent of the #4 oil shipments represent a reasonably reliable procedure. Consumption of residual fuel oil by commercial sources also was estimated from total heating oil shipments [12]. In this case, partitioning was made on the basis of combined commercial employment relative to total employment [14].

*Estimates of anthracite coal for residential use were derived from tabulations supplied by APCO based on shipments reported by the Commonwealth of Pennsylvania, Department of Mines.

Gross consumption of bituminous coal by commercial sources was assembled from Bureau of Mines tabulations [10] and extrapolated to 1970 again based on the trend observed from a review of shipments in earlier years. Estimates of anthracite coal use for commercial heating were derived from tabulations supplied by APCO from shipments to New Hampshire cities and towns as reported by the Commonwealth of Pennsylvania, Department of Mines.

Fuel use by large commercial boilers was inventoried separately from questionnaire information as described in Section B.4. The balance between this reported point source fuel, and the gross regional totals estimated above, was classified as consumption by area sources. Further partitioning of this area source fuel was based on city and town commercial employment data [14].

3. Manufacturing

Combustion of fuel by manufacturing sources is for the purpose of satisfying both space heating requirements and process needs. Gross consumption of distillate oil, residual oil, coal, wood, and propane gas was compiled from the questionnaire file assembled by the New Hampshire Air Pollution Control Agency. Industrial use of natural gas was obtained directly from utility company sales information.

Fuel use by individual large manufacturing sources was inventoried separately as described below. The balance between this point source fuel and the gross regional totals was classified as consumption by area sources. Partitioning of this area source fuel was based on city and town industrial employment data [14] adjusted for the employment by point sources.

4. Commercial and Industrial Point Sources

Point sources are defined as those industrial establishments and other boiler installations within the State which consume large quantities of fuel, and thereby may represent large local air pollution emission sources. Detailed information on these facilities was obtained from

the State Agency questionnaire file and supplemented by an extensive telephone survey.

All questionnaire responses were reviewed and only those indicating annual air pollutant emissions of at least 10 tons were designated as combustion point sources.

5. Steam-Electric Utilities

Steam-electric utilities constitute a large class of fuel use in the State, and also provide the most accurately reported data. Fuel use by each power plant was obtained from questionnaire data, and supplemented by information from Federal Power Commission Reports [15].

C. TRANSPORTATION SOURCES

1. Automotive

Estimates of air pollutant emissions from automotive traffic in the State were based on total sales of motor fuels derived from 1969 tax records and extrapolated to 1970 [16]. This was separated into rural and urban travel based on statewide vehicle-mile figures [17]. Finally, consumption of diesel fuel by trucks, trailer-tractors, buses, etc., was estimated from the vehicle-mile data* based on a consumption factor of 5.1 mi/gal.

2. Aircraft

Estimates of total air traffic at municipal and private airfields in the State were obtained through the New Hampshire Aeronautics Commission [18]. These totals were partitioned further into commercial and private traffic on the basis of airline schedules. Airline schedules also were used to classify aircraft type for commercial traffic. Information on air traffic at Pease Air Force Base was not made available during the course of this study.

*Traffic by diesel-powered vehicles was assumed to be 2 percent of the total.

3. Railroads

Total consumption of residual oil and diesel fuel by railroads for steam and power was obtained from previously cited Bureau of Mines tabulations [12] extrapolated (decreased) to 1970. These values were distributed among the cities and towns in the State on the basis of industrial employment.

4. Vessels

Consumption of diesel fuel by motor ships was similarly extracted from Bureau of Mines reports [12] and extrapolated to 1970. Residual fuel oil use by steamships was estimated from waterborne shipping information reported by the U.S. Army Corps of Engineers [19]. Both residual oil and diesel fuel were distributed among navigable waterways in the State on the basis of the traffic data reported by the Corps of Engineers.

D. INDUSTRIAL PROCESS LOSS

The discharge of pollutants into the atmosphere from raw material processing can arise from a broad class of industrial operations. The development of reliable estimates of emissions from these sources often requires a detailed knowledge of the individual plant design, method of operation, production data, and installed control equipment. The existing file of questionnaires were reviewed and only those indicating annual emissions of at least 1 ton were inventoried. Where additional information was required to evaluate the source, the State Agency performed further telephone contact.

E. GASOLINE AND SOLVENT EVAPORATION

Emissions of gasoline due to evaporation during storage, handling, and marketing operations were estimated from the application of appropriate emission factors [20] to gasoline sales data.

The emission of solvent vapors from the application of surface coatings, dry cleaning and degreasing operations, and other industrial

processes using solvents was estimated from city and town population data and an assumed per capita value of 30 lb/yr [21]. This per capita value is composed on the average of 50.9% for surface coatings (paint), 7.0% for dry cleaning, 16.5% for degreasing and 25.6% for all other miscellaneous uses. A summary of 1970 population counts is given in Appendix C.

F. REFUSE DISPOSAL

The weight of household refuse was estimated from city and town population data and an assumed per capita generation of 5 lb/day. These estimates were further adjusted for the seasonal influence of tourism. The methods for disposal of this waste was assumed to be 95% in municipal facilities, and 5% by backyard burning in towns with less than 20,000 inhabitants; cities with greater than 20,000 inhabitants were assumed to provide 100% disposal in municipal facilities. Communities with less than 40 residents were assumed to use only backyard burning disposal methods. Industrial waste inventoried from the point source questionnaire file was added to the municipal disposal load.

An incinerator study conducted by the State Agency is currently in its initial phase. Since no substantial data were available, on-site incineration was estimated from city and town population data and an assumed per capita generation of 2 lb/day [22].

G. EMISSION FACTORS AND FUEL PARAMETERS

Computation of pollutant emissions from the combustion of fuel, combustion of solid waste, or raw material processing operations was performed by the application of appropriate emission factors. A compilation of these emission factors has been assembled and published by the Environmental Protection Agency [20]. These factors were used in estimating emissions for the current study.

Fuel parameters on sulfur content and ash content reported by the specific sources inventoried were used in estimating emissions. Where no such values were reported, and for the calculation of emissions from area sources, the values given in Table IV were used [22].

H. REACTIVE HYDROCARBON EMISSIONS

A partitioning of total hydrocarbon emissions from all sources was made on the basis of an assigned reactivity designation to the various hydrocarbon species. This assignment classified all hydrocarbon emissions other than solvent vapors to be in the reactive class [21]. For solvent vapors, a special telephone survey was conducted to characterize compound use patterns. The principal classes of solvent users considered were surface coating (paints), dry cleaning, and degreasing. The average percentage distribution of sales reported are presented in Table V. A fourth unspecified class containing all miscellaneous uses for adhesives, printing inks, etc., could not be easily resolved because of the highly specialized marketing of these products by manufacturers and distributors. Consequently, they were all assumed to be reactive compounds.

The census of manufacturers shows annual shipments of paint by New England firms to be nearly equally distributed between industrial use and trade use. Applying these shipments data as weighting factors to the partitioning between solvent base and water base paints produces an overall distribution of 33.6% for water base and 66.4% for solvent base. This differs slightly from the national average which is 25% for water base and 75% for solvent base.

Applying the results of this special survey to the per capita solvent use produces an overall weighted distribution of 74% reactive and 26% non-reactive.

I. GRID SQUARE SUMMARIES

To facilitate the subsequent use of the emission inventory for the purpose of investigating control strategies by means of computer simulation modeling, the city and town summaries for Southern New Hampshire (including the town of Lebanon) were distributed into the grid square network described previously. This distribution was performed on the basis of land use surveys where detailed data were available from planning agencies [23]. Land use summarized by class of use, i.e., residential,

commercial, manufacturing, transportation, etc., for census tracts or traffic zones were used to proportion the city and town emissions totals into grid squares. Because the census tracts, traffic zones, and grid squares represent a smaller scale than the city and town level, the spatial resolution of emissions should be enhanced. For communities without equivalent land use data, U.S. Geologic Survey maps were used to partition community emissions into grid squares.

The distribution of emissions into grid squares was applied only to area sources. All other emission sources which were individually inventoried were not included in the grid square summaries. These included:

Commercial and manufacturing fuel burning point sources
Process emission sources
Municipal incinerators and open burning dumps
Steam-electric utilities
Airports

The complete inventory consists of 77 grid square summaries and 464 individual emission sources. The distribution of these point sources is illustrated in Figure 9. A list of political jurisdiction numbers used for coding the city or town location for point and area sources is given in Appendix B.

J. ALLOWABLE EMISSIONS

Allowable emissions of sulfur oxides and particulates were calculated for all point sources. Two sets of allowable emission calculations were performed. The first of these was based on existing New Hampshire Air Pollution Control Commission Regulations. Another set of allowable emission computations was based upon the Federal Model Regulations [24]. The results from these calculations were entered into the point source data punch card decks.

III. RESULTS

A summary of the annual emissions by source type for each Air Quality Control Region is presented in Tables I, II and III. The relative contribution by each source category for the five pollutants mentioned is shown in Figures 4-8. Further resolution of the area source emissions within the AQCR's into city and town values is provided by the data tabulation in a Data Supplement to this report.

The results derived from partitioning total hydrocarbon emissions into reactive species for the Southern New Hampshire AQCR is presented in Table VI.

IV. CONCLUSIONS

An inventory of fuel use and emission estimates for the year 1970 has been prepared for the State of New Hampshire. The inventory has been summarized in this report on a Regional basis. A supplementary data report provides similar machine tabulations of fuel use and emissions for each municipality in the State. Summaries of fuel use and emissions also have been prepared for a network of grid squares, and list of point sources. All data used to prepare the inventory are available in the form of computer punch cards and machine tabulations. The composite of all tabulations provides a comprehensive picture of air pollutant emissions in the Air Quality Control Regions.

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APPENDIX A

COORDINATE TRANSFORMATION BETWEEN ADJACENT UTM GRID SYSTEM SECTORS

The Universal Transverse Mercaptor (UTM) grid coordinate mapping system is based on division of the globe into sectors which are 6 degrees in longitude. One of these division lines occurs in the western half of the State of New Hampshire along the 72°W meridian of longitude. To avoid an ambiguity in the coordinate location of the sources inventoried throughout the State, a continuous system was constructed by extending the sector grid system east of the 72°W longitude across the western part of the State. An empirical set of transformation formulae were developed to perform the conversion. The equations are:

$$X_E = X_W \cdot \cos\theta - Y_W \cdot \sin\theta + X_o \quad (1)$$

$$Y_E = Y_W \cdot \cos\theta + X_W \cdot \sin\theta + Y_o \quad (2)$$

where X_W is the true UTM horizontal coordinate (km) of a point west of 72°W

Y_W is the true UTM vertical coordinate (km) of a point west of 72°W

X_E is the equivalent horizontal coordinate (km) of the point in the extended grid coordinate system

Y_E is the equivalent vertical coordinate (km) of the point in the extended grid coordinate system

θ has the fixed value -4.141316 degrees

X_o has the fixed value -821.260 km

Y_o has the fixed value +66.2102 km

The accuracy of this transformation is better than 0.1 km over the region of interest.

APPENDIX B

POLITICAL JURISDICTION CODES

TABLE B-1

POLITICAL JURISDICTION CODES FOR THE MERRIMACK VALLEY-
SOUTHERN NEW HAMPSHIRE AQCR (REGION NO. 121)

REGION	POLITICAL JURISDICTION	TOWN
121	29	ALTON
121	29	BARNSTEA
121	29	BELMONT
121	29	CENTER H
121	33	GILFORD
121	29	GILMANTO
121	32	LACONIA
121	31	MEREDITH
121	30	NEW HAMP
121	29	SANBORNT
121	34	TILTON
121	35	ALSTEAD
121	35	CHESTERF
121	36	DUBLIN
121	37	FITZWILL
121	35	GILSUM
121	36	HARRISVI
121	38	HINSDALE
121	39	JAFFREY
121	40	KEENE
121	36	MARLBORO
121	35	MARLOW
121	36	NELSON
121	36	RICHMOND
121	36	RINDGE
121	36	ROXBURY
121	35	STODDARD
121	35	SULLIVAN
121	35	SURRY
121	41	SWANZEY
121	42	TROY
121	43	WALPOLE
121	35	WESTMORE
121	44	WINCHEST
121	45	AMHERST
121	46	ANTRIM
121	47	BEDFORD
121	46	BENNINGT
121	45	BROOKLIN
121	46	DEERING
121	46	FRANCEST
121	48	GOFFSTOW
121	46	GREENFIE
121	45	GREENVIL
121	46	HANCOCK
121	49	HILLSBOR
121	45	HOLLIS
121	50	HUDSON
121	51	LITCHFIE
121	45	LYNDEBOR
121	52	MANCHEST
121	45	MASON
121	53	MERRIMAC
121	54	MILFORD
121	45	MONT VER
121	55	NASHUA
121	56	NEW BOST
121	57	NEW IPSW
121	58	PELHAM
121	59	PETERBOR
121	45	SHARON
121	45	TEMPLE
121	46	WEARE
121	60	WILTON
121	46	WINDSOR
121	61	ALLENSTO
121	62	ANDOVER
121	62	BOSCAWEN
121	63	BOW
121	62	BRADFORD
121	61	CANTERBU
121	61	CHICHEST
121	64	CONCORD
121	62	DANBURY
121	61	DUNBARTO
121	61	EPSOM
121	65	FRANKLIN
121	62	HENNIKER
121	62	HILL
121	66	HOOKSETT
121	67	HOPKINTO
121	61	LOUDON
121	62	NEWBURY
121	68	NEW LOND
121	61	NORTHFIE
121	69	PEMBROKE
121	70	PITTSFIE
121	62	SALISBUR
121	62	SUTTON
121	62	WARNER
121	62	WEBSTER
121	62	WILMOT
121	71	ATKINSON
121	71	AUBURN
121	72	BRENTWOO
121	71	CANDIA
121	71	CHESTER
121	71	DANVILLE
121	71	DEERFIEL
121	73	DERRY
121	72	E. KINGS
121	74	EPPING
121	75	EXETER
121	72	FREMONT
121	72	GREENLAN
121	71	HAMPSTEA
121	76	HAMPTON
121	72	HAMPTON
121	72	KENSINGT
121	72	KINGSTON
121	77	LONDONDE
121	78	NEW CAST
121	79	NEWFIELD
121	81	NEWINGTO
121	80	NEWMARKE
121	72	NEWTON
121	72	NORTH HA
121	71	NORTHWOO
121	82	PLAISTOW
121	83	PORTSMOU
121	71	RAYMOND
121	84	RYE
121	85	SALEM
121	71	SANDOWN
121	86	SEABROOK
121	72	SOUTH HA
121	72	STRATHAM
121	87	WINDHAM
121	88	BARRINGT
121	89	DOVER
121	90	DURHAM
121	91	FARMINGT
121	88	LEE
121	88	MADBURY
121	88	MIDDLETO
121	88	MILTON
121	88	NEW DURH
121	92	ROCHESTE
121	93	ROLLINSF
121	94	SOMERSWO
121	69	STRAFFOR
121	95	ACWORTH
121	96	CHARLEST
121	97	CLAREMON
121	98	CORNISH
121	99	CROYDON
121	95	GOSHEN
121	99	GRANTHAM
121	95	LANGDON
121	95	LEMPSTER
121	99	NEWPORT
121	99	PLAINFIE
121	99	SPRINGFI
121	95	SUNAPEE
121	95	UNITY
121	95	WASHINGT

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TABLE B-2

POLITICAL JURISDICTION CODES FOR THE CENTRAL NEW HAMPSHIRE INTRASTATE AQCR (REGION NO. 149)

REGION	POLITICAL JURISDICTION	GUN
149	1	ALBANY
149	2	BARTLETT
149	3	BROOKFIE
149	4	CHATHAM
149	5	CONWAY
149	6	EATON
149	7	EFFINGHA
149	8	FREEDOM
149	9	HALES LO
149	10	HARTS LO
149	11	JACKSON
149	12	MADISON
149	13	MOULTONB
149	14	OSSIPEE
149	15	SANDWICH
149	16	TAMWORTH
149	17	TUFTONBO
149	18	WAKEFIEL
149	19	WOLFEBOR
149	20	ALEXANDR
149	21	ASHLAND
149	22	BATH
149	23	BENTON
149	24	BETHLEHE
149	25	BRIDGEWA
149	26	BRISTOL
149	27	CAMPTON
149	28	CANAAN
149	29	DORCHEST
149	30	EASTON
149	31	ELLSWORT
149	32	ENFIELD
149	33	FRANCONI
149	34	GRAFTON
149	35	GROTON
149	36	HANOVER
149	37	HAVERHIL
149	38	HEBRON
149	39	HOLDERNE
149	40	LANDAFF
149	41	LEBANON
149	42	LINCOLN
149	43	LISBON
149	44	LITTLETO
149	45	LYMAN
149	46	LYME
149	47	MONROE
149	48	ORANGE
149	49	ORFORD
149	50	PIERMONT
149	51	PLYMOUTH
149	52	RUMNEY
149	53	THORNTON
149	54	WARREN
149	55	WATERVIL
149	56	WENTWORT
149	57	WOODSTOC
149	58	SUGAR HI

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TABLE B-3

POLITICAL JURISDICTION CODES FOR THE ANDROSCOGGIN VALLEY INTERSTATE AQCR (REGION NO. 107)

REGION	POLITICAL JURISDICTION	CODE
107	1	ATKINSON
107	2	BEANS GR
107	3	BEANS PU
107	4	BERLIN
107	5	CAMBRIDG
107	6	CARROLL
107	7	CHANDLER
107	8	CLARKSVI
107	9	COLEBRCO
107	10	COLUMBIA
107	11	CRAWFORD
107	12	CUTTS GR
107	13	DALTON
107	14	DIXS GRA
107	15	DIXVILLE
107	16	DUMMER
107	17	ERROL
107	18	ERVINGS
107	19	GROVETON
107	20	GORHAM
107	21	JEFFERSO
107	22	KILKENNY
107	23	LANCASTE
107	24	LOW & BU
107	25	MARTINS
107	26	MILAN
107	27	MILLSFIE
107	28	NORTHUMB
107	29	ODELL
107	30	PINKHAMS
107	31	PITTSBUR
107	32	RANDOLPH
107	33	SARGENTS
107	34	SHELBURA
107	35	STARK
107	36	STEWARTS
107	37	STRATFOR
107	38	SUCCESS
107	39	THOMPSON
107	40	WENTWORT
107	41	WHITEFIE

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APPENDIX C

REGIONAL POPULATION SUMMARIES

TABLE C-1

REGIONAL POPULATION SUMMARIES

Region	Population
Androscoggin Valley	34,291
Central New Hampshire	73,462
Southern New Hampshire	629,928
TOTAL	737,681

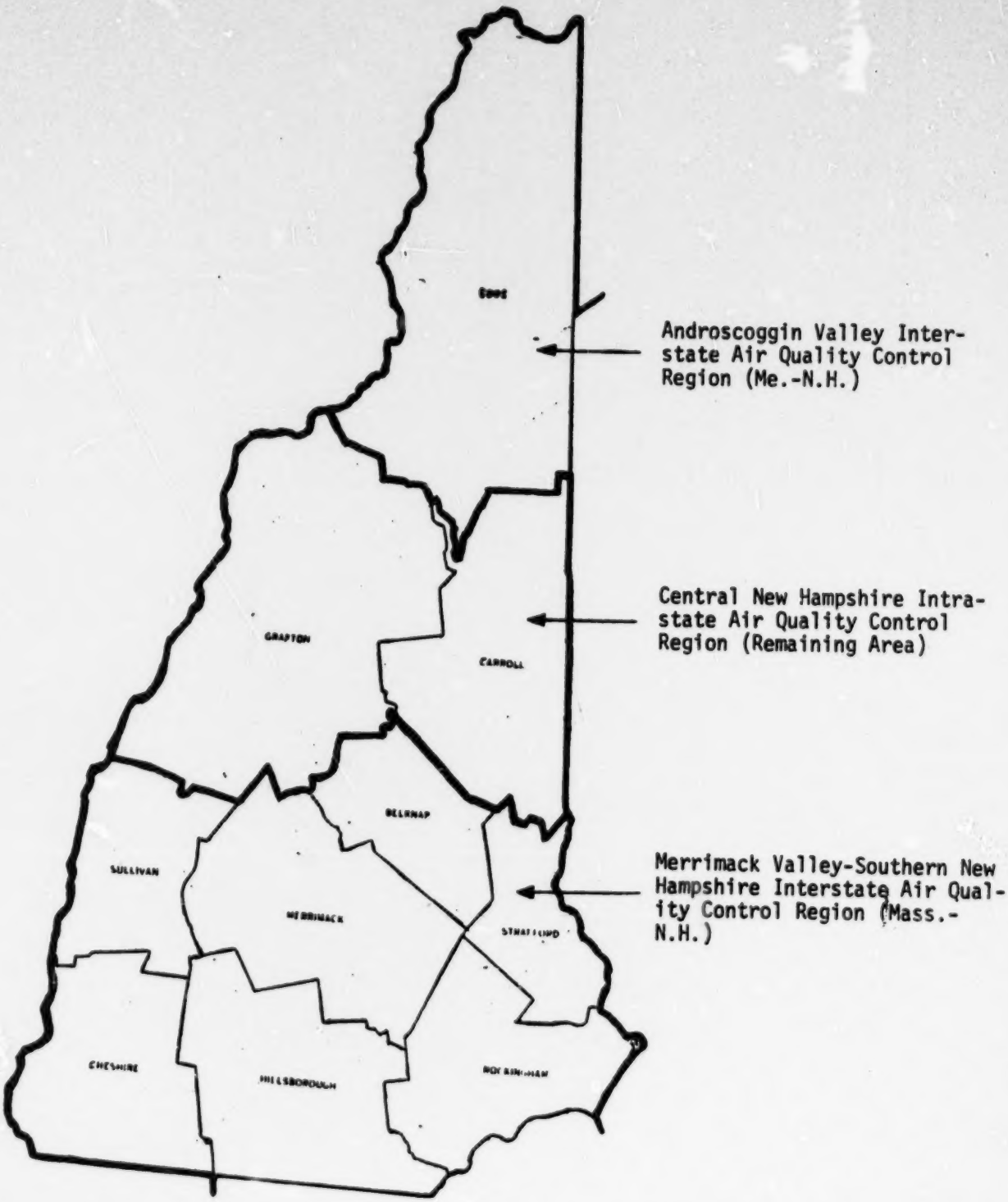


Figure 1. State of New Hampshire Air Quality Control Regions.

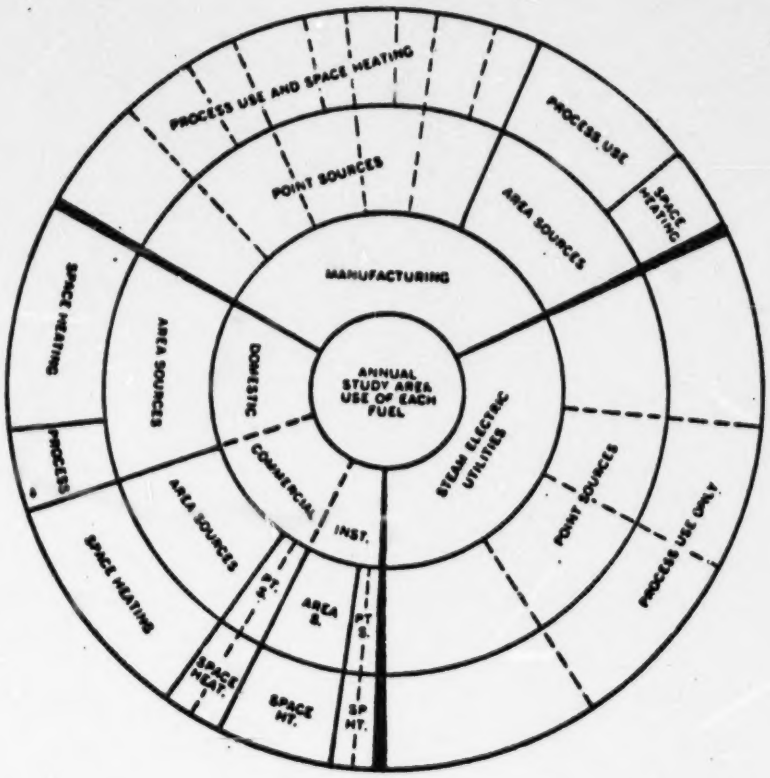
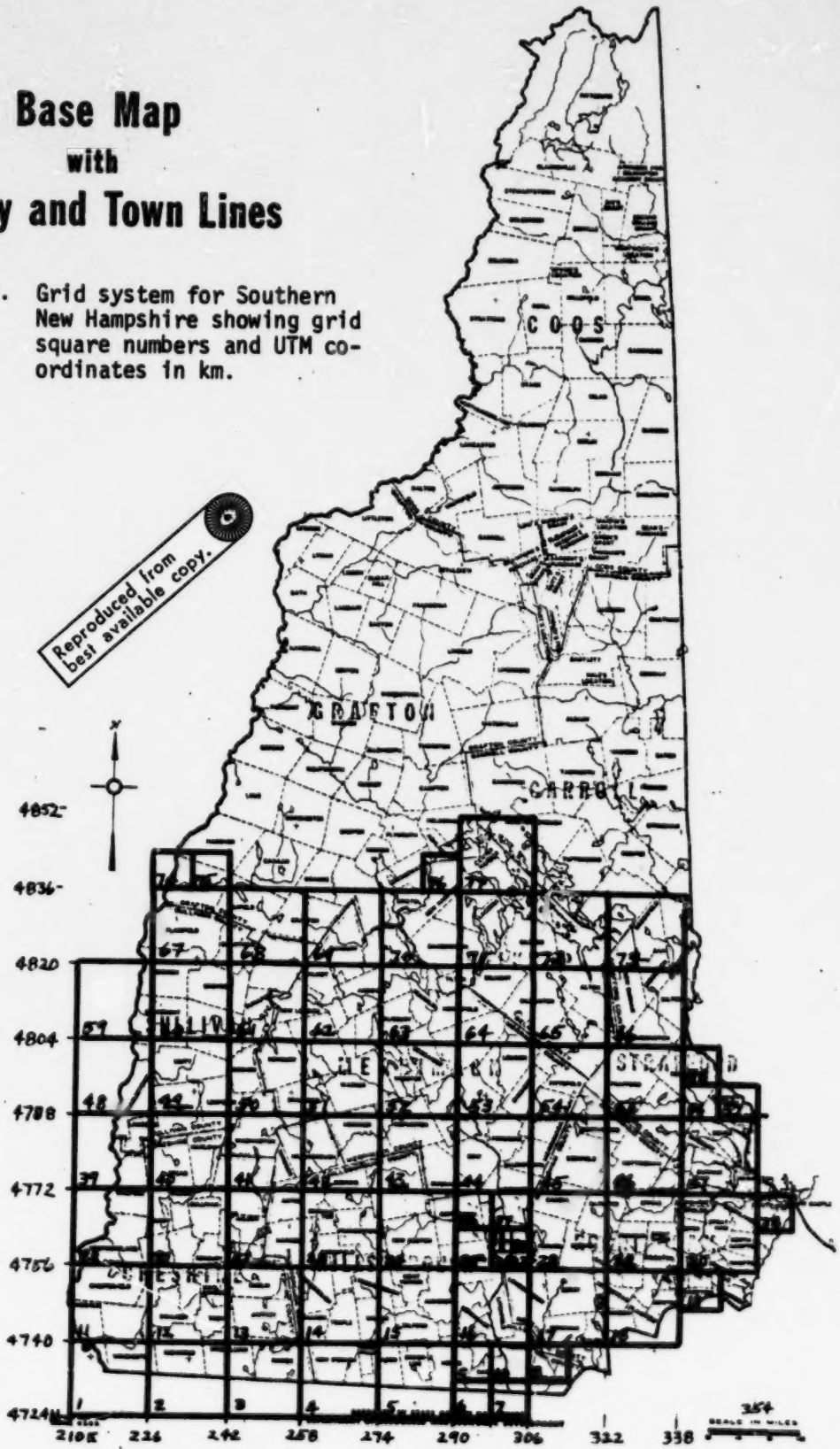


Figure 2. Subdivision of Total Fuel Consumption into User Categories and Type of Use (After Ref. 3).

Base Map
with
County and Town Lines

Figure 3. Grid system for Southern New Hampshire showing grid square numbers and UTM co-ordinates in km.



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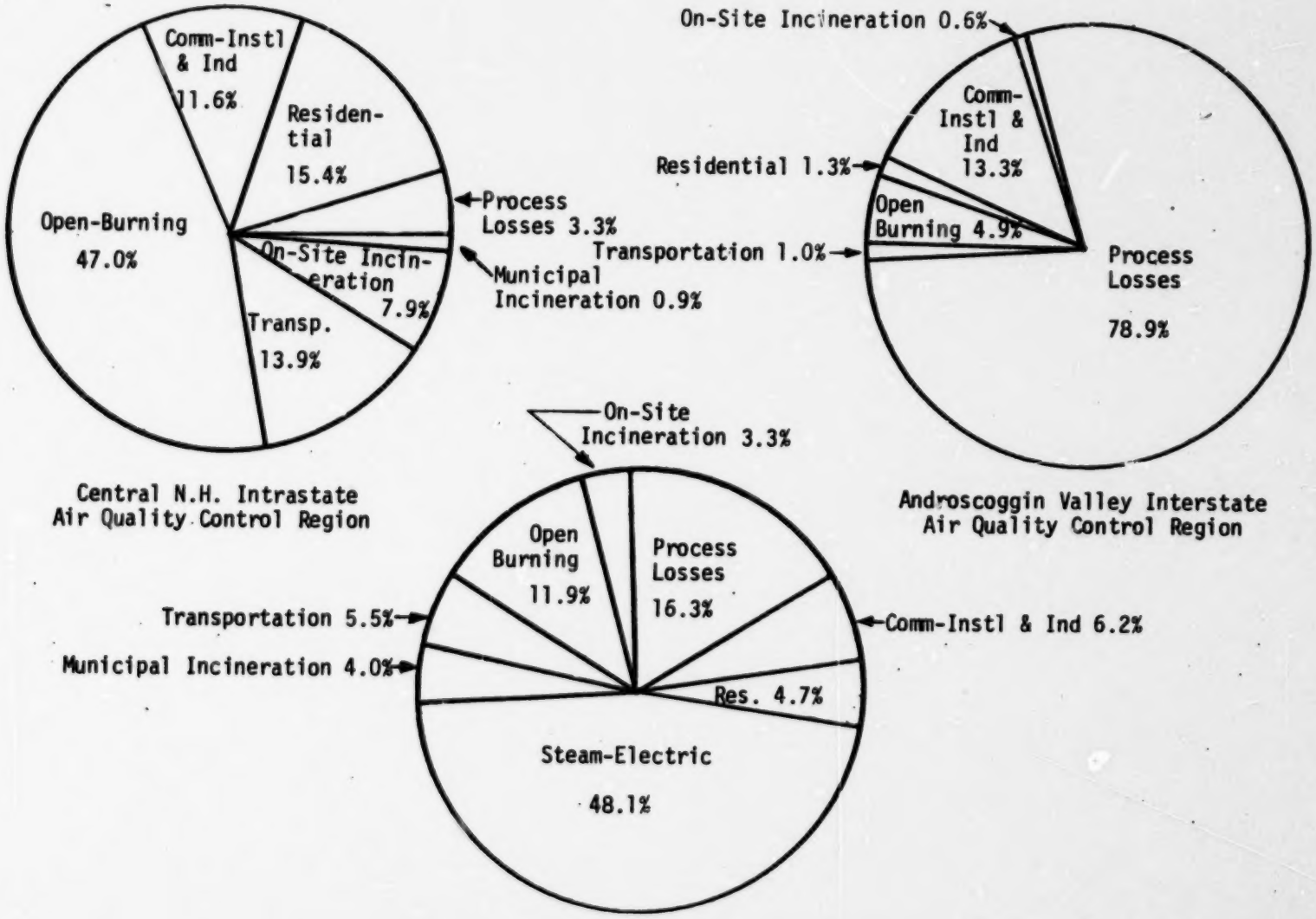

Figure 4. Relative Distribution of Particulate Emissions by Source Category.

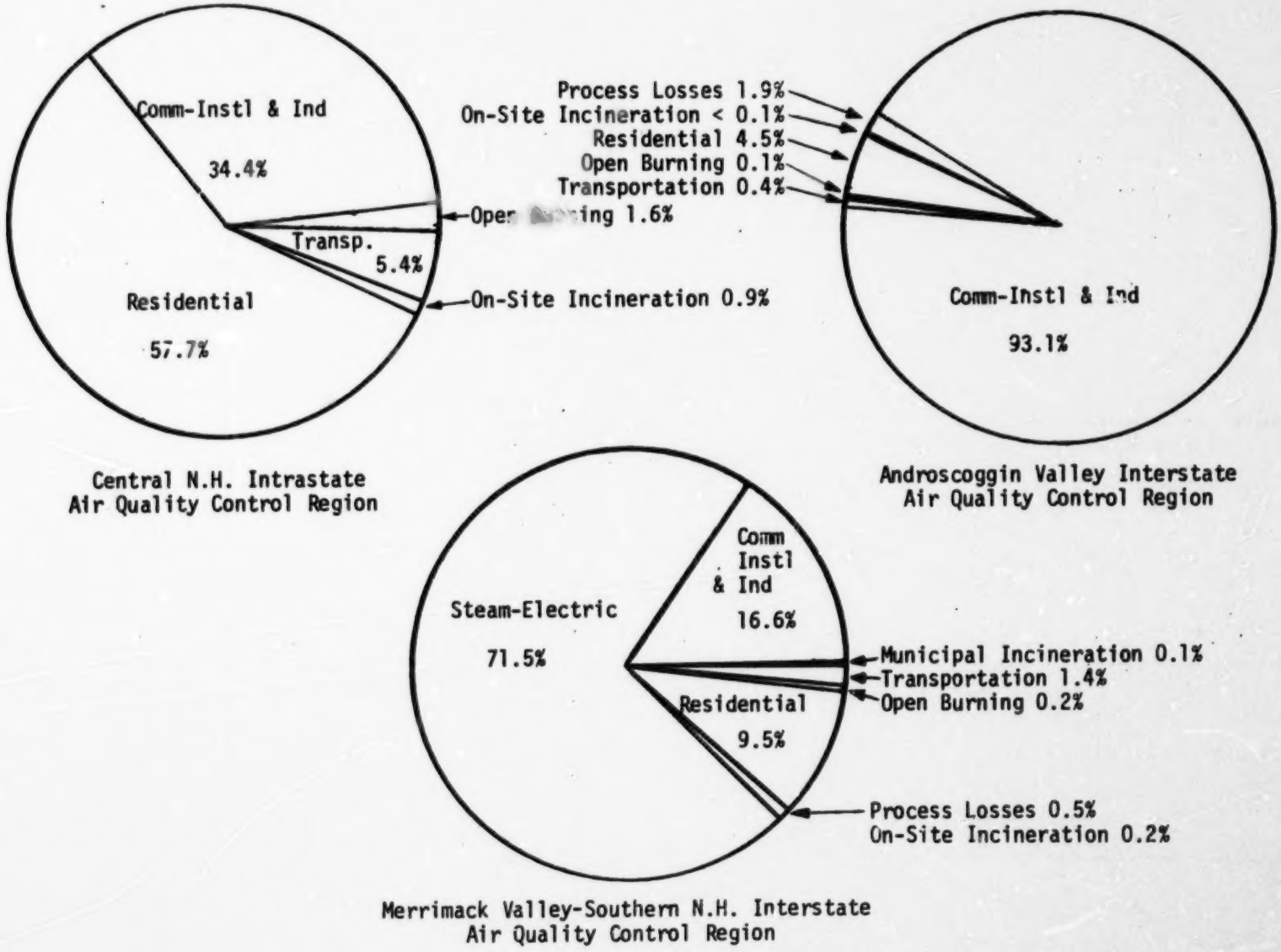

Figure 5. Relative Distribution of SO_x Emissions by Source Category.

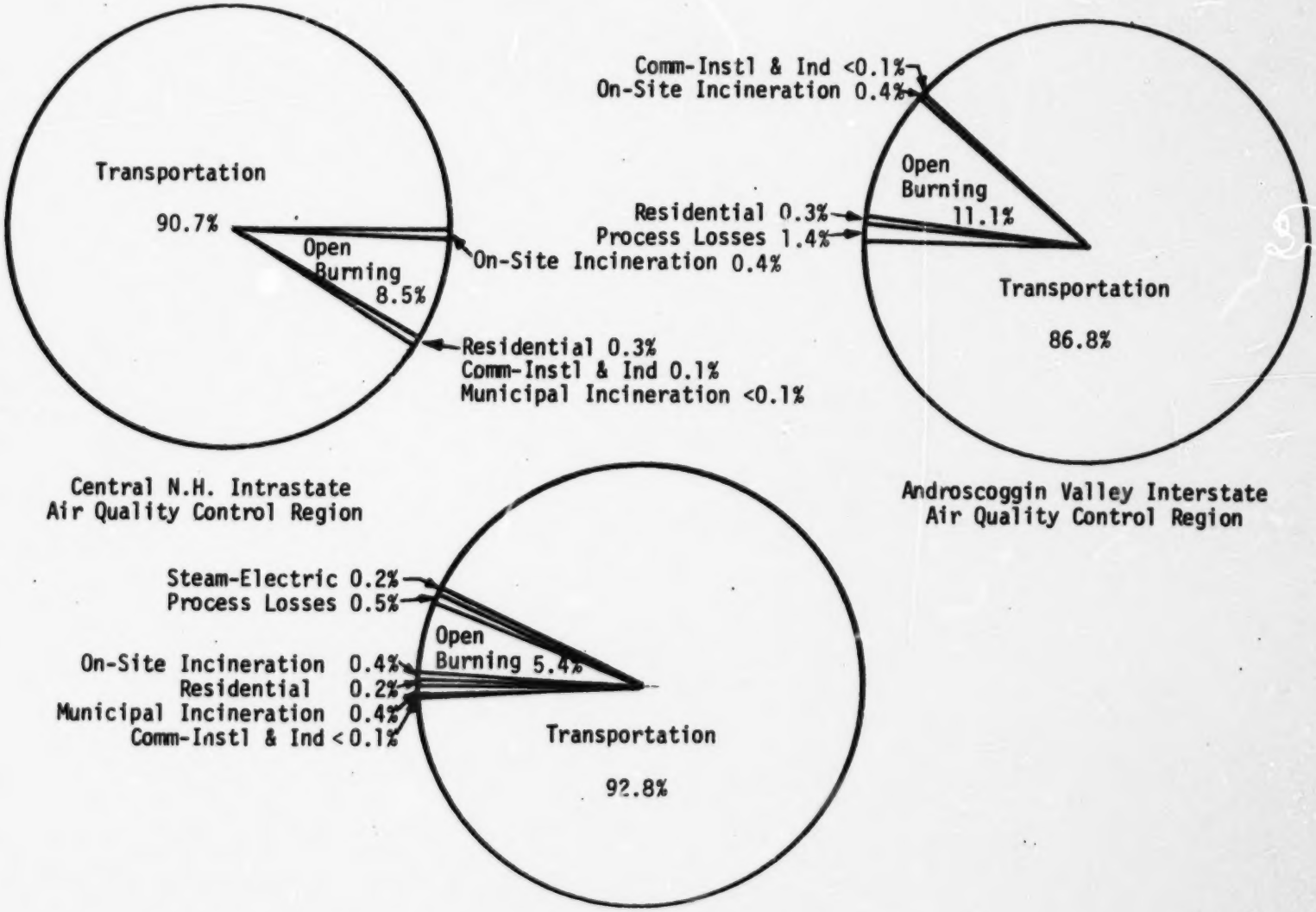

Figure 6. Relative Distribution of Carbon Monoxide (CO) Emissions by Source Category.

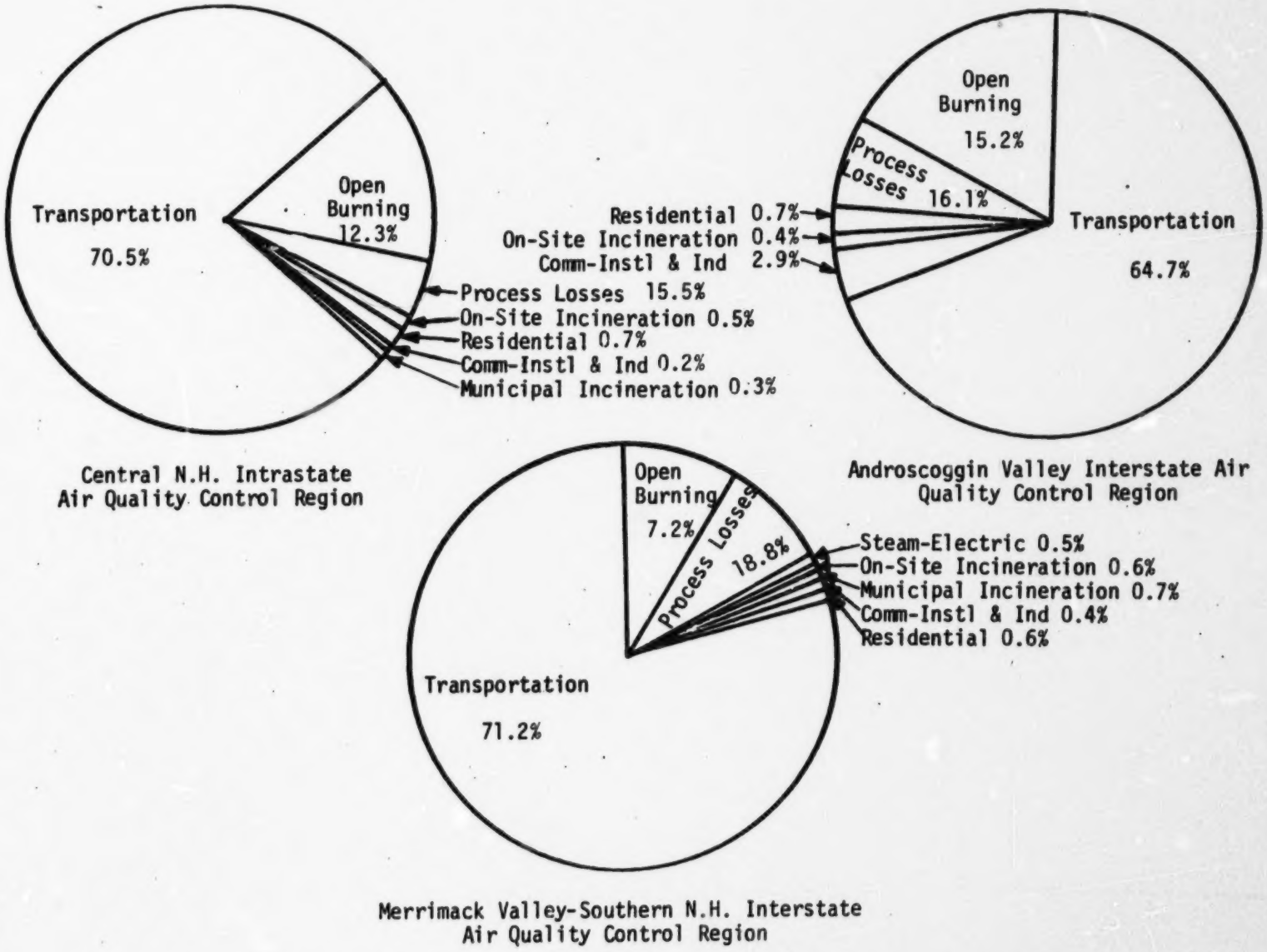

Figure 7. Relative Distribution of Hydrocarbon (HC) Emissions by Source Category.

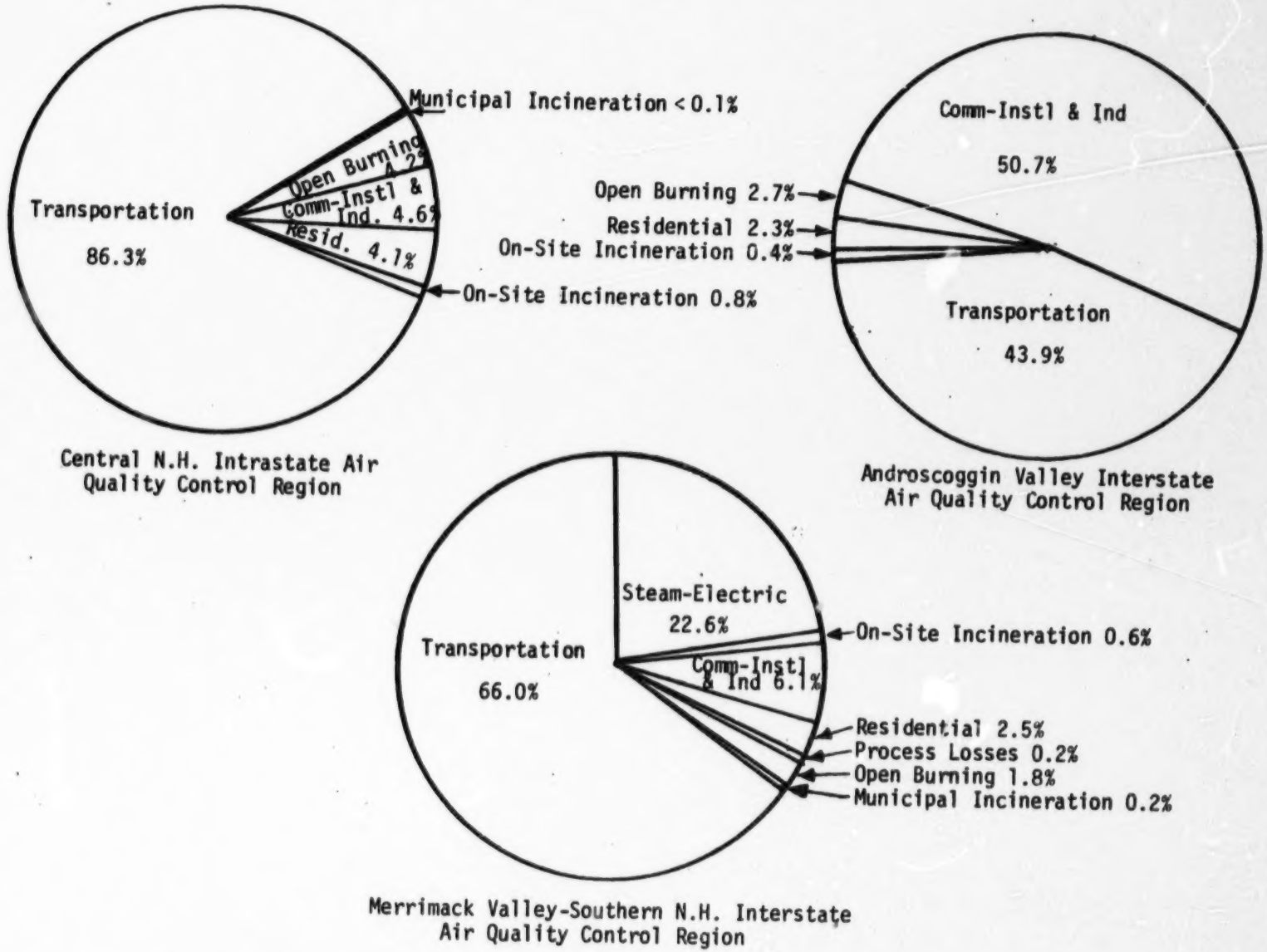

Figure 8. Relative Distribution of NO_x Emissions by Source Category.

Base Map
with
County and Town Lines

Figure 9. Statewide distribution of point sources.

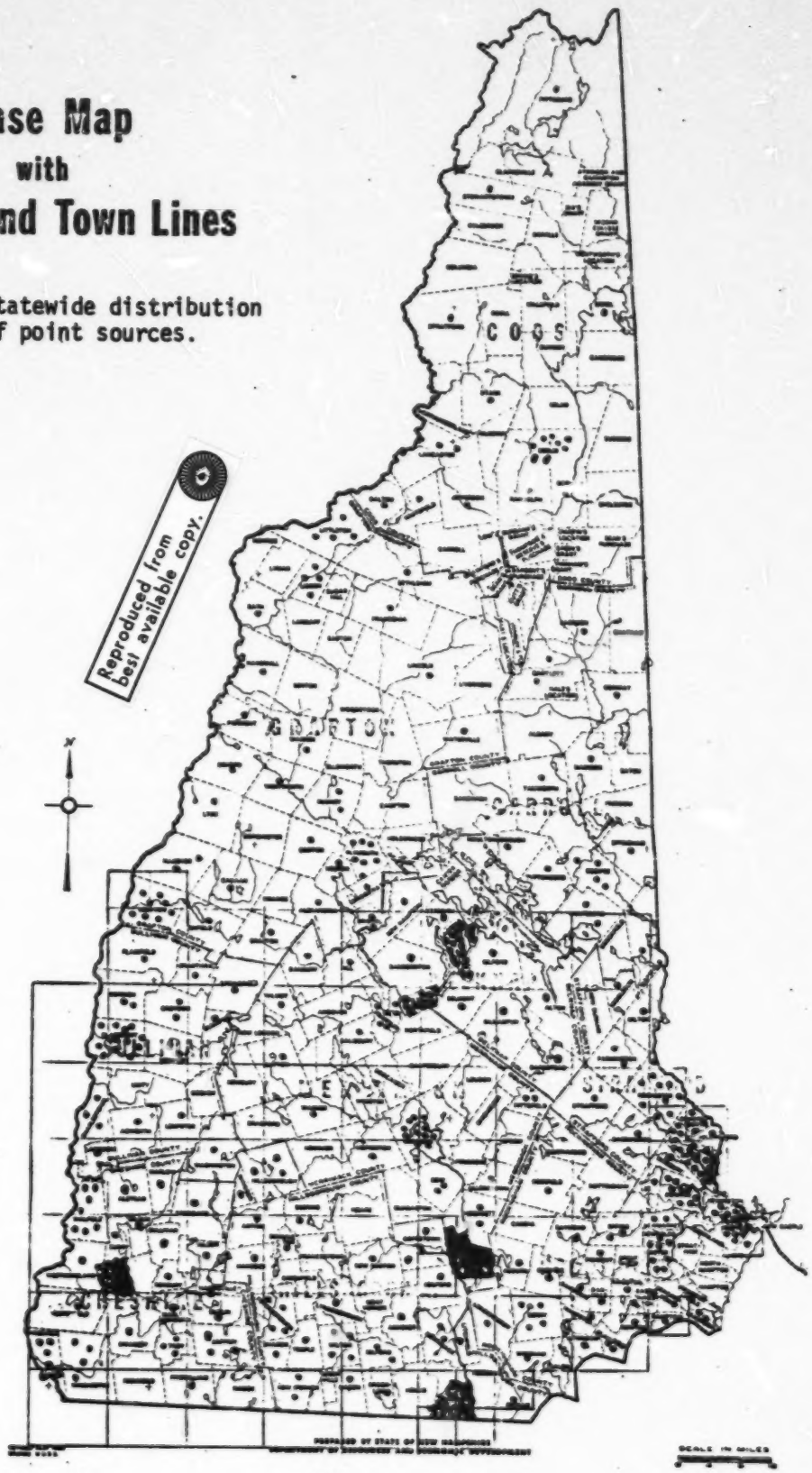

TABLE I

EMISSIONS INVENTORY SUMMARY

FOR THE STATE OF NEW HAMPSHIRE, MERRIMACK VALLEY - SOUTHERN NEW HAMPSHIRE INTERSTATE AIR QUALITY CONTROL REGION - DATA REPRESENTATIVE OF CALENDAR YEAR 1970

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. Fuel Combustion							
A. Residential Fuel-Area Source							
1. Coal	20	71	78	19	8	3,133	tons
2. Distillate Oil	1,131	8,143	566	339	1,357	226,207	thou gal
3. Natural Gas	37	1	39	16	148	3,944	mil cu ft
4. Wood							
5. Other							
6. Total	1,188	8,215	683	374	1,513		
B. Comm-Instl & Ind							
1.a. Coal-Area Source	86	128	74	18	13	3,673	tons
b. Coal-Point Source	64	215	31	7	23	5,663	tons
2. Coke-Point Source*							
3.a. Distillate Oil-Area Source	260	1,249	4	52	1,041	34,701	thou gal
b. Distillate Oil-Point Source	43	400	1	9	171	5,694	thou gal
4.a. Residual Oil-Area Source	99	1,506	1	13	258	8,612	thou gal
b. Residual Oil-Point Source	762	10,873	7	100	2,011	66,631	thou gal
5.a. Natural Gas-Area Source	14	0	6	22	106	1,588	mil cu ft
b. Natural Gas-Point Source	4	0	0	8	34	399	mil cu ft
6. Process Gas-Point Source							
7.a. Wood-Area Source	8	0	1	1	3	564	tons
b. Wood-Point Source	255	0	30	18	94	18,083	tons
8.a. Propane-Area Source	4	0	0	9	27	1,402	thou gal
b. Other-Point Source							
9. Total	1,599	14,371	155	257	3,781		
C. Steam-Electric Power Plant							
1. Anthracite Coal							
2. Bituminous Coal	11,766	48,697	550	165	9,900	1,100	thou ton

*Included under process losses

WALDEN RESEARCH CORPORATION

TABLE I (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. C. Steam-Electric Power Plant							
3. Distillate Oil 4. Residual Oil 5. Natural Gas 6. Other	298	13,039	1	186	3,914	74,550	thou gal
7. Total	12,064	61,736	551	351	13,814		
D. Total Fuel Combustion	14,851	84,322	1,389	982	19,108		
II. Process Losses							
A. Area Sources (Solvents)	0	0	0	9,448	0	9,448	tons
B. Point Sources*	4,100	442	1,633	4,432	94		
III. Solid Waste Disposal							
A. Incineration							
1.a. On Site-Area Source	816	175	1,165	350	350	233,031	tons
b. On Site-Point Source	14	1	19	15	2	2,269	tons
2. Municipal, etc.-Point Source	942	71	1,267	446	144	82,094	tons
B. Open Burning							
1.a. On Site-Area Source	138	9	732	258	52	17,231	tons
b. On Site-Point Source							
2.a. Dumps-Area Source							
b. Dumps-Point Source	2,847	172	15,108	5,333	1,065	357,247	tons
C. 1. Other-Area Source							
2. Other-Point Source							
D. Total Solid Waste Disposal	4,757	428	18,291	6,402	1,613		

*Includes process fuel use of 3600 tons coal, 2219 thou gal residual oil, 850 thou gal distillate oil, and 420 tons coke.

WALDEN RESEARCH CORPORATION

TABLE I (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
IV. Transportation-Area Source							
A.1. Motor Vehicles-Gasoline	1,128	683	271,486	48,848	37,482	3,416	mil vehicle-miles
2. Motor Vehicles-Diesel	212	382	2,758	552	2,886	16,974	thou gal
B. Off-Highway Fuel Usage							
C. Aircraft	32	83	478	43	29	86	thou LTO
D. Railroads	2	6	6	5	7	182	thou gal
E. Vessels	3	35	2	6	3	220	thou gal
F. Gasoline Hndlg Evap. Losses	0	0	0	3,100	0	3,100	tons
G. Other							
H. Total Transportation	1,377	1,189	274,730	52,554	40,407		
V. Miscellaneous-Area Sources							
A. Agricultural Burning							
B. Other							
C. Total Miscellaneous							
VI. Grand Total							
A. Area Source	3,958	12,388	276,918	63,056	43,741		
B. Point Source	21,128	73,993	19,125	10,762	17,481		
C. Total	25,086	86,381	296,043	73,818	61,222		

TABLE II

EMISSIONS INVENTORY SUMMARY

FOR THE STATE OF NEW HAMPSHIRE, CENTRAL NEW HAMPSHIRE INTRASTATE AIR QUALITY CONTROL REGION - DATA REPRESENTATIVE OF CALENDAR YEAR 1970

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. Fuel Combustion							
A. Residential Fuel-Area Source							
1. Coal	3	11	12	3	1	484	tons
2. Distillate Oil	181	1,303	90	54	217	36,188	thou gal
3. Natural Gas						0	
4. Wood							
5. Other							
6. Total	184	1,314	102	57	218		
B. Comm-Instl & Ind							
1.a. Coal-Area Source	10	15	9	2	2	436	tons
b. Coal-Point Source	13	64	7	2	4	1,300	tons
2. Coke-Point Source							
3.a. Distillate Oil-Area Source	32	153	0	6	128	4,251	thou gal
b. Distillate Oil-Point Source	1	6	0	0	3	90	thou gal
4.a. Residual Oil-Area Source	14	214	0	2	37	1,227	thou gal
b. Residual Oil-Point Source	21	331	0	3	55	1,819	thou gal
5.a. Natural Gas-Area Source						0	
b. Natural Gas-Point Source						0	
6. Process Gas-Point Source							
7.a. Wood-Area Source	1	0	0	0	0	61	tons
b. Wood-Point Source	46	0	8	4	17	3,809	tons
8.a. Propane-Area Source	0	0	0	1	2	128	thou gal
b. Other-Point Source							
9. Total	138	783	24	20	248		
C. Steam-Electric Power Plant							
1. Anthracite Coal							
2. Bituminous Coal							

WALDEN RESEARCH CORPORATION

TABLE II (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. C. Steam-Electric Power Plant							
3. Distillate Oil							
4. Residual Oil							
5. Natural Gas							
6. Other							
7. Total							
D. Total Fuel Combustion	322	2,097	126	77	466		
II. Process Losses							
A. Area Sources (Solvents)	0	0	0	1,101	0	1,101	tons
B. Point Sources	39	0	0	225	0		
III. Solid Waste Disposal							
A. Incineration							
1.a. On Site-Area Source	94	20	134	40	40	26,814	tons
b. On Site-Point Source							
2. Municipal, Etc.-Point Source	7	0	12	29	1	917	tons
B. Open Burning							
1.a. On Site-Area Source	27	2	143	51	10	3,369	tons
b. On Site-Point Source							
2.a. Dumps-Area Source							
b. Dumps-Point Source	533	34	2,818	997	214	66,432	tons
C. 1. Other-Area Source							
2. Other-Point Source							
D. Total Solid Waste Disposal	661	56	3,107	1,117	265		

TABLE II (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
IV. Transportation-Area Source							
A.1. Motor Vehicles-Gasoline	129	78	31,154	5,605	4,301	392	mil vehicle-miles
2. Motor Vehicles-Diesel	19	35	252	50	263	1,548	thou gal
B. Off-Highway Fuel Usage							
C. Aircraft	18	10	47	10	15	13	thou LTO
D. Railroad	0	1	1	0	1	17	thou gal
E. Vessels						0	
F. Gasoline Hndlg Evap. Losses	0	0	0	356	0	356	tons
G. Other							
H. Total Transportation	166	124	31,454	6,021	4,580		
V. Miscellaneous-Area Sources							
A. Agricultural Burning							
B. Other							
C. Total Miscellaneous							
VI. Grand Total							
A. Area Source	510	1,832	31,795	7,271	5,002		
B. Point Source	678	445	2,892	1,270	308		
C. Total	1,188	2,277	34,687	8,541	5,310		

TABLE III

EMISSIONS INVENTORY SUMMARY
FOR THE STATE OF NEW HAMPSHIRE, ANDROSCOGGIN VALLEY INTERSTATE AIR QUALITY CONTROL REGION - DATA REPRESENTATIVE OF CALENDAR YEAR 1970

Source Category	Tons of Pollutant/Year					Fuel, etc.	
	Part.	SO_2	CO	HC	NO_x	Quantity	Units
I. Fuel Combustion							
A. Residential Fuel-Area Source							
1. Coal	2	6	7	2	1	276	tons
2. Distillate Oil	97	698	48	29	116	19,390	thou gal
3. Natural Gas							
4. Wood							
5. Other							
6. Total	99	704	55	31	117		
B. Comm-Instl and Ind							
1. a. Coal-Area Source	4	6	4	1	0	173	tons
b. Coal-Point Source							
2. Coke-Point Source							
3. a. Distillate Oil-Area Source	12	60	0	2	50	1,669	thou gal
b. Distillate Oil-Point Source	2	7	0	0	6	207	thou gal
4. a. Residual Oil-Area Source	5	95	0	1	15	496	thou gal
b. Residual Oil-Point Source	986	14,386	9	129	2,572	85,745	thou gal
5. a. Natural Gas-Area Source							
b. Natural Gas-Point Source							
6. Process Gas-Point Source							
7. a. Wood-Area Source*	0	0	0	0	0	20	tons
b. Wood-Point Source							
8. a. Other-Area Source	0	0	0	1	2	89	thou gal
b. Other-Point Source							
9. Total	1,009	14,554	13	134	2,645		

*Less than 1/2 ton emissions

WALDEN RESEARCH CORPORATION

TABLE III (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
I. C. Steam-Electric Power Plant							
1. Anthracite Coal							
2. Bituminous Coal							
3. Distillate Oil							
4. Residual Oil							
5. Natural Gas							
6. Other							
7. Total							
D. Total Fuel Combustion	1,108	15,258	68	165	2,762		
II. Process Losses							
A. Area Sources (Solvents)	0	0	0	514	0	514	tons
B. Point Sources	6,000	291	250	220	0		
III. Solid Waste Disposal							
A. Incineration							
1.a. On Site-Area Source	46	10	65	20	20	13,099	tons
b. On Site-Point Source						0	
2. Municipal, Etc.-Point Source						0	
B. Open Burning							
1.a. On Site-Area Source	14	1	73	26	5	1,726	tons
b. On Site-Point Source							
2.a. Dumps-Area Source							
b. Dumps-Point Source	357	20	1,900	670	134	44,722	tons
C. 1. Other-Area Source							
2. Other-Point Source							
D. Total Solid Waste Disposal	417	31	2,038	716	159		

TABLE III (Cont.)

Source Category	Tons of Pollutant/Year					Fuel Etc.	
	Part	SO_2	CO	HC	NO_x	Quantity	Units
IV. Transportation-Area Source							
A. 1. Motor Vehicles-Gasoline	63	38	15,259	2,745	2,106	192	mil vehicle-miles
2. Motor Vehicles-Diesel	13	24	175	35	183	1,078	thou gal
B. Off-Highway Fuel Usage							
C. Aircraft*							
D. Railroad	0	0	0	0	0	11	thou gal
E. Vessels						0	
F. Gasoline Hndlg Evap. Losses	0	0	0	174	0	174	tons
G. Other							
H. Total Transportation	76	62	15,434	2,954	2,289		
V. Miscellaneous-Area Sources							
A. Agricultural Burning							
B. Other							
C. Total Miscellaneous							
VI. Grand Total							
A. Area Source	256	938	15,631	3,550	2,498		
B. Point Source	7,345	14,705	2,159	1,019	2,713		
C. Total	7,601	15,643	17,790	4,569	5,211		

*Less than 1/2 ton emissions

TABLE IV

FUEL PARAMETERS

Fuel	Sulfur (percent)	Ash (percent)
Northern New Hampshire		
Coal		
Bituminous	2.60	10.0
Anthracite	0.70	10.6
Residual Oil	2.40	--
Distillate Oil	0.50	--
Natural Gas	0.001	Neg.
Central and Southern New Hampshire		
Coal		
Bituminous	2.60	10.0
Anthracite	0.70	10.6
Residual Oil	2.20	--
Distillate Oil	0.50	--
Natural Gas	0.001	Neg.

TABLE V

DISTRIBUTION OF SOLVENT SALES

Use	Reactive	Non-Reactive
Paint		
Industrial	100% solvent base	0% water base
Trade	35% solvent base	65% water base
Dry Cleaning	10% stoddard solvent	90% perchlorethylene
Degreasing	85% trichlorethylene	15% trichlorethane

TABLE VI

HYDROCARBON EMISSION INVENTORY FOR SOUTHERN NEW HAMPSHIRE

Source Category	Emissions (tons/yr)		
	Reactive	Non-Reactive	Total
Transportation	49,454	0	49,454
Fuel Combustion	982	0	982
Solid Waste Disposal	6,402	0	6,402
Organic Solvent Users	6,991	2,457	9,448
Industrial Process	4,432	0	4,432
Gasoline Marketing	3,100	0	3,100
TOTAL	71,361	2,457	73,818